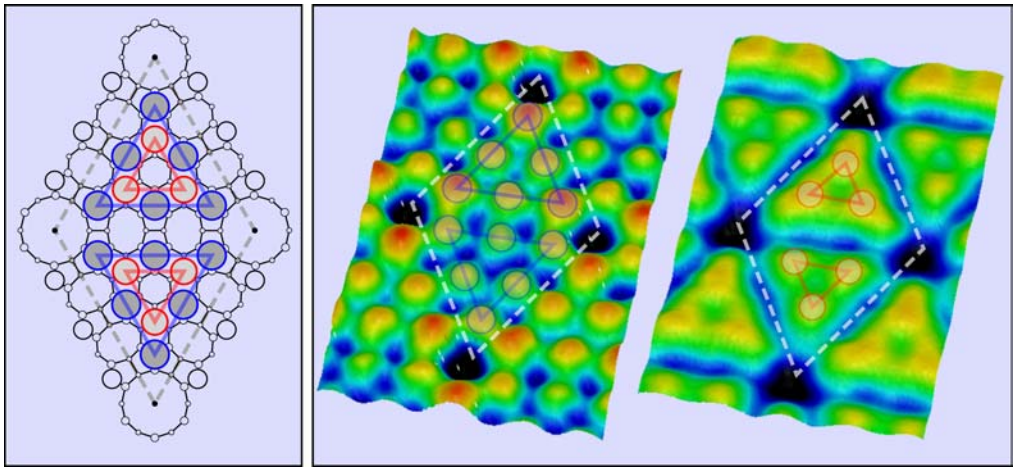
Color Filtering at the Atomic Level

Peter Sutter, Colorado School of Mines, Career (DMR-9985178)

Scanning tunneling microscopy (STM) uses a sharp metal tip to map conducting surfaces (e.g., of metals) with atomic resolution. Conventional STM is generally most sensitive to the highest-energy occupied electron states on a surface, and cannot discern lower-energy electrons, which may be associated with different atoms or different kinds of chemical bonds.

We have demonstrated a new technique, "energy-filtered STM", which uses a semiconductor tip analogous to a color filter in an optical microscope. Just as color filters make it easier to discern desired features in a photograph, color-filtered STM makes it easier to distinguish between chemically similar atoms.



Selective Imaging of Different Atoms on Silicon (Si).

Left: Schematic top view of the (111) surface of Si, showing two types of near-surface Si atoms [adatoms (blue) & rest atoms (red)].

Right: Energy-filtered STM images, demonstrating the selective imaging of the adatoms and rest atoms at different tip-sample bias voltage.

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Education

4 Undergraduate Students: Peter Johnson, John Hamilton, Matthew Jensen, Bao Nguyen.

4 Graduate Students: Eugene Ley, Yuki Yoshida, Jacob Palmer, Ian Schick.

Contributions from 2 International Postdocs: Percy Zahl (Germany, now at IBM Zurich Labs), Winfried Ernst (Germany).

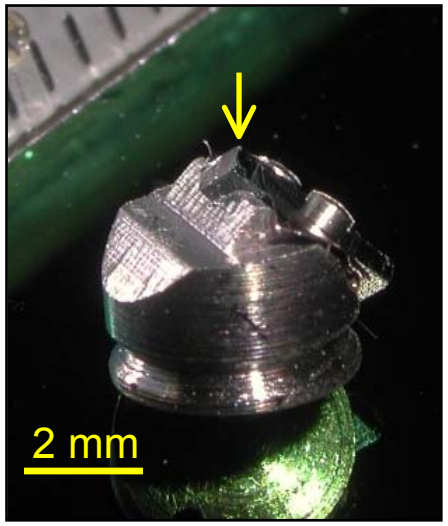
Dissemination

Invited presentation at "12th Int. Conference on Scanning Tunneling Microscopy".

Public seminars at Colorado State University (Fort Collins, CO), Brookhaven National Laboratory (Upton, NY), Universities of Rome 'Tre' and 'Tor Vergata' (Rome, Italy), Forschungszentrum Juelich (Juelich, Germany).

Outreach

Interaction with middle school students under the umbrella of a nationwide initiative "NEC Extreme Science - Give a Day, Make a Difference" by the NEC Foundation of America.



Development of Experimental Methods: Tip holder enabling the use of semiconductor tips for energy-filtered tunneling microscopy.